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EXECUTIVE SUMMARY

In Tanzania, a lightning strike killed a teacher and six students in 2015 – another sad example of the thousands of deaths that could easily be avoided with the effective deployment of modern weather and climate services. Providing these services not only saves lives, but is also central to building resilience to climate change, empowering nations and strengthening livelihoods across Africa's most vulnerable communities.

A NEW VISION

for Weather and Climate Services in Africa

OVERVIEW

CELL PHONES HAVE BECOME UBIQUITOUS ACROSS SUB-SAHARAN AFRICA, OFFERING AN EASY PLATFORM FOR THE DISTRIBUTION OF EARLY WARNINGS OF IMPENDING HAZARDOUS WEATHER CONDITIONS AND CLIMATE INFORMATION TO BOTH RURAL AND URBAN AREAS. PHOTO BY ©IFAD/MWANZO MILLINGA.

The collection, analysis and distribution of reliable weather, water and climate information—collectively referred to as climate and weather services—has the potential to greatly benefit efforts by African nations to reduce poverty, build resilience and adapt to a changing climate. For over 30 years, the international development community has made substantial investments in the procurement of weather, water and climate technologies, with the goal of improving weather and climate services for Africa. Nevertheless, today, according to the World Bank, "most hydromet services in sub-Saharan Africa are unable to meet current needs for weather and climate information, and offer only limited areas of transboundary cooperation."[1] In this report a new vision is explored to address sub-Saharan Africa's weather, water and climate monitoring and forecasting needs. The presentation of this new vision begins with a review of challenges with traditional approaches for improving the delivery of weather and climate services. A new approach is proposed that provides Africa's least-developed countries with end-to-end systems that can produce and deliver early warnings and climate information that can save lives, boost productivity and protect the environment.

This new vision includes the deployment of advanced hydrometeorological observing and forecasting technologies, capacity-building and enabling policies that fortify the position of Africa's National HydroMeteorological Services (NHMS) as well as the formulation of new partnerships between the public and private sectors. Creating a sustainable model for the delivery of effective weather and climate services across sub-Saharan Africa will require policymakers to critically examine the status quo and adopt this new vision for the implementation of this essential public service. This goes beyond the simple procurement and installation of new technologies, to an end-to-end systems approach. There is no silver bullet, but with effectively structured public-private partnerships, new technology and services, strengthened institutions, increased regional cooperation and continued capacity-building, sustainable solutions to providing climate and weather services are a realistic and attainable goal. Reaching this target will have a significant impact on the achievement of the Sustainable Development Goals, protecting lives and building powerful resilience for Africa and beyond.[2]

Building Resilience to Climate Change

Sub-Saharan Africa is already facing a combination of challenges perhaps greater than any other region—rapid population growth, urbanization leading to megacities, challenges in providing basic services, the lowest rates of electricity and energy access in the world, low rates of agricultural productivity, and outbreaks of disease. Despite continued economic growth and advances in food security, constraints in regional cooperation, capacity limitations in NHMSs and related government agencies, and challenges in access to new technologies, information and training remains persistent and creates tough-to-break poverty traps that hinder progress in resilient development and poverty reduction. Today in Africa, an estimated 330 million people live in extreme poverty, with projections from the World Bank's Global Monitoring Report indicating only small gains in poverty reduction in sub-Saharan Africa over the next 15 years.[3]

AN ALL-IN-ONE AUTOMATIC WEATHER STATION (AWS) BEING INSTALLED ON A CELL-PHONE TOWER NEAR KOTIDO, UGANDA. FIVE SUCH AWS HAVE BEEN INSTALLED ON CELL TOWERS ACROSS UGANDA THROUGH THE COUNTRY'S STRENGTHENING CLIMATE INFORMATION AND EARLY WARNING SYSTEMS PROJECT. CONNECTED DIRECTLY INTO THE TELEPHONE BACKBONE NETWORK, THE DATA ARE SENT TO UGANDA NATIONAL METEOROLOGICAL AUTHORITY (UNMA) FOR PROCESSING AND ANALYSIS. THE FIVE STATIONS, EACH OF WHICH ALSO INCLUDES A LIGHTNING LOCATING SENSOR, WILL PROVIDE DATA TO AN END-TO-END MONITORING AND FORECASTING SYSTEM, WHICH ALLOWS UNMA TO ISSUE EARLY WARNINGS FOR IMPENDING HAZARDOUS THUNDERSTORMS, CONNECT WITH REGIONAL MONITORING SYSTEMS AND IMPROVE THE COUNTRY'S OVERALL SUSTAINABILITY OF INVESTMENTS IN CLIMATE INFORMATION SERVICES. PHOTO BY SOLOMON MANGENI

Climate and weather services encompass the effective collection, analysis, packaging and distribution of weather, water and climate information. These basic public services include the issuance of early warnings of fast-acting storms, wildfires and other extreme events, and the provision of climate information to assist in long-term planning and decision making. The vision goes well beyond a simple procurement-based approach and takes a systematic end-to-end approach where climate and weather products meet the needs of end users. According to the World Meteorological Organization (WMO), services should be "timely, dependable and reliable, usable, useful, credible, authentic, responsive and flexible, sustainable (affordable and consistent over time), and expandable (to be applicable to different kinds of services)".[4]

For example, providing vulnerable farming communities with improved weather and climate services has the potential to increase farmers' productivity while helping them better manage their risks. With better information on extreme weather events and more actionable information on what to do when bad weather hits, farmers can protect lives, livestock and property. Credible, localized climate information can also support farmers in obtaining

credit and accessing risk-management mechanisms like index-based insurance. They can also create long-term plans for a future that will be highly dependent on changing rainfall patterns.

Investment in weather and climate services is smart business, with a fivefold or greater return in economic development for every dollar spent.[5] In addition to better protecting lives and livelihoods, decision makers can use weather and climate information to inform the development of National Adaptation Plans, strengthen local and national economies, enhance food security, and build climate-smart infrastructure designed to perform well through a time of changing climate. Private sector enterprises can also use the information to inform their own adaptation strategies in the face of climate impacts, including uncertainty, while on the community level, village leaders can develop climate-resilient strategies to improve local enterprises and protect productive assets.

While much of the international focus on climate change has centred on mitigation—the African continent, with a few limited exceptions, has a very limited ability to affect global mitigation. All of the emissions from sub-Saharan Africa amounts to only a few percent of total global greenhouse gas emissions. At the same time, African nations are very vulnerable to the impacts of climate change. Consequently, the climate change focus for African countries has mainly to do with adaptation—increasing resilience and reducing as much as possible the adverse impacts of climate change.

But how? And with what resources? The operationalization of the Green Climate Fund holds forth the promise of greater financial support for adaptation, particularly for the poorest and most vulnerable countries, but how can such funds be used most effectively without reliable data on weather and climate?[6] And how can nations build new revenue streams to encourage the sustainability of investments in weather and climate services?

A New Vision

This report focuses on a new vision for enabling actions that present immediate opportunities to enhance the capacity of African countries to prepare for climate change and to simultaneously achieve other economic, environmental and social goals.

Innovative technologies and business models have come together to offer new ways of collecting, analyzing and communicating weather, water and climate information. The technological basis for this new vision is relatively recent innovations in weather and climate monitoring, analysis and forecasting technologies, as well as parallel advances in computing and cellular telecommunication services.

The new technologies include All-in-One Automatic Weather Stations, lightning location sensors, automatic water level and stream gages, and central automated systems for data collection, integration and analysis. These technologies, together with modern forecaster workstations, comprise an end-to-end weather and climate monitoring and forecasting system well suited to the constraints and capabilities of developing countries.

While the hardware is relatively straightforward, it can only be applied fully and effectively if the public sector takes the lead to engage a new group of private-sector actors that are working in the climate and weather services space. From a big picture perspective, these partnerships provide an essential ingredient in supporting the enabling environment necessary to increase the sustainable uptake of end-to-end solutions. These partnerships can be leveraged to foster long-term support for the maintenance and integration of climate monitoring systems within existing systems to guide national, sub-national and sector-based planning and budgeting, improve value propositions, and support sustainable revenue generation.

Market research has made it evident that a number of sectors, such as aviation, agriculture, banking, energy, insurance, resource extraction and telecommunications are willing to pay for high-quality weather and climate information products. In the absence of a reliable local service provider, international private-sector weather service providers are providing such products. However, the quality of these products is limited by a lack of local

data or experience. This presents an opportunity for National HydroMeteorological Services to engage in revenue-sharing agreements with private-sector weather service providers to produce better, more competitive products. For most African countries this is a dramatic, almost revolutionary prospect.

National efforts to modernize the current status of weather and climate services in sub-Saharan Africa have been inadequate at best, or, in many areas, non-existent.[7] Consequently, despite many qualified staff making their best efforts, National HydroMeteorological Services are not a significant source of weather, water and climate information for most businesses and individuals (with limited exceptions, such as in aviation, due to legal requirements). In recent years, this has led to new concerns within National HydroMeteorological Services in response to increased local competition from international private-sector weather service providers.

Since the mid-1980s, donor support for modernizing weather and climate services in developing countries has conservatively totalled almost US$1 billion, with the majority of commitments since 2000.[8] Nevertheless, a recent WMO monitoring survey showed that "54% of the surface and 71% of the upper air weather stations in the region did not report data," leading the World Bank to call for an additional 5,000 weather monitoring systems to be deployed across Africa.[9] So what hasn't worked? And why do National HydroMeteorological Services in sub-Saharan Africa remain caught in a non-virtuous cycle where systems break down and are not maintained; resources are constrained; and vulnerable communities still need to look to the sky to understand local weather systems, or, even worse, where local planting and crop management traditions are turned on their head by changing weather patterns, droughts, severe storms and floods?

The approach described in this report emerged from UNDP's response to requests from 11 African nations to help them address this situation.

FLOODS NOT ONLY PUT LIVES AT RISK, THEY ALSO DESTROY PRODUCTIVE INFRASTRUCTURE LIKE ROADS. PHOTO BY UNDP.

The specific challenges are complex and nuanced. They vary by country but typically include some combination of poor planning for ongoing expenses and skills required for the maintenance, service and management of weather and climate monitoring and forecasting systems. They also include a preference for technological solutions that work well in the developed world but are not well suited for the unique rigors of deployment in sub-Saharan Africa, as well as poor integration between disparate donor-supported investments in the hydromet services space. In addition, there have also been any number of regional and local challenges that have the tendency to derail non-customized solutions for Africa's persistent development challenges and perpetuate the aforementioned non-virtuous cycle.

A benefit of the innovative technologies and business models described in this report is that they advance climate adaptation goals, including reducing the impact of storms, lightning and other extreme weather events through the timely communication of warnings as well as the collection of real-time weather data, which is valuable for short-term-weather and long-term-climate forecasts. Consequently, they can (and already have) received support from climate funds, which are expected to become increasingly available as a product of the UN Framework Convention on Climate Change.

Engagement with the private sector will be a key component to addressing some of these persistent challenges.[10] According to the publication, creating effective public-private partnerships requires internal commitment and leadership, a conducive regulatory framework and business environment, sustained financial and political support, transparent and effective procurement processes, clear allocation of risks, and continual monitoring and evaluation.

There is no one-size-fits-all blueprint to structuring effective PPPs within the hydromet services sectors. The individual political structures, socio-economic realities and business environments will define individual narratives. The single common thread is one of trust, shared risk and mutual benefit. The end goals remain the same: to bridge the last mile to bring valuable public-information alerts to vulnerable communities across Africa, to build new revenue streams for National HydroMeteorological Services (NHMS), and to create a true value proposition that fosters the long-term sustainability of climate information endeavours.

The challenges raised by this new vision are thus in part technical—introducing new technologies and vendors and demonstrating the effectiveness of their products and services—but even more so they involve the need to change established ways of doing things, create bespoke solutions, ensure the long-term sustainability of investments, overcome an existing lack of trust between the public and private sectors, and create different ways of operating that focus on going beyond the procurement of technologies to an end-to-end systematic approach. This is not an easy task, but the potential rewards are so great that a significant effort to make it happen is justified.

In the end, addressing the challenges of climate change—and building smart adaptation mechanisms across sub-Saharan Africa that include credible and reliable weather and climate services—will require engagement with a broad grouping of actors from both the public and private sectors. In order to make it work, African nations will need to take the lead, taking a series of enabling actions that engage the numerous actors that are coming together to provide weather and climate services. By engaging with these potential partners—and working to establish win-win relationships—African nations have the opportunity to ensure the long-term sustainability of investments in monitoring and forecasting systems, build resilience to a changing climate, and create working models that provide valuable climate information and early warning systems to the vulnerable farmers and communities that need them the most. As with any initiative, these innovative approaches will need to be carefully monitored and evaluated, allowing practitioners and NHMS leaders to test and pilot innovation, measure its impact and adjust approaches to foster long-term sustainability.

THE COST OF BAD WEATHER

Driven by large-scale changes in global and regional climate over the last four decades, floods, droughts, changing weather patterns, sporadic or increased rains, and other hydromet-related disasters are affecting African agricultural productivity at an astonishing rate. If the rate of climate change does not alter its current course, serious issues of public health and food security will come to the forefront of both regional and global agendas.

Inequality, poor value-chain linkages and lack of productive infrastructure already mean the continent loses an estimated $4 billion worth of grain annually due to post-harvest losses. "About 25 to 40 percent of the food produced on the continent is lost because of inadequate harvest, storage and transport practices. Market access has remained weak and very little food makes it up the value chain."

WEATHER IMPACT — THE BIG PICTURE WORLDWIDE

1.94 MILLION DEATHS (1970–2012)

$2.4 TRILLION IN ECONOMIC LOSSES (1970–2012)

BY THE NUMBERS

650 MILLION PEOPLE live in arid or semi-arid areas where floods and droughts impact lives and productivity (WFP)

50% The possible increase in the cost of corn if climate change continues (Mary Robinson Climate Justice Foundation)

2 BILLION extra mouths to feed by 2050 (Mary Robinson Climate Justice Foundation)

15% The percentage of wheat crops Egypt expects to lose if temperatures rise 2°C (IFPRI)

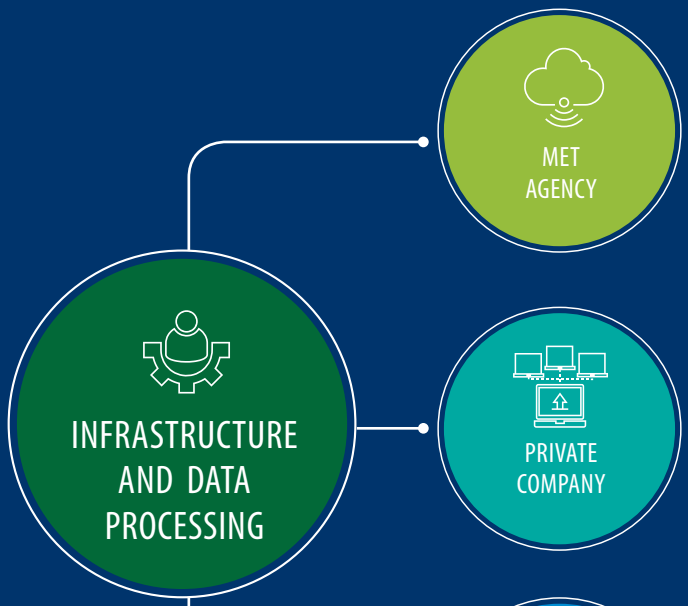
1 IN 4 sub-Saharan Africans remain undernourished (IFPRI)

5%-22% Possible crop decline in sub-Saharan Africa if global warming continues by 2050 (IFPRI)

1-2 DEGREES CELSIUS Anticipated temperature jump by 2050

50% Nearly half of all emergency multilateral food assistance to Africa is in response to natural disasters (ARC)

ESTABLISHING SHARED RESPONSIBILITY



- Data ownership
- Shared data creates sustainability model
- Secured cloud computing instead of servers
- Training builds capacity to fully utilize and operate the network

- Contractualy defined data access
- **NHMS** cost recovery assistance to sustain network
- Development of end user services
- Supports Met Agency with training and technical expertise

- Purchase data and services developed by each party of jointly
- Industies: Emergency Management, Aviation, Utilities, Agriculture, Mining, Petroleum and others

Examining Win-Wins, Challenges and Opportunities

POTENTIAL BENEFITS

PUBLIC SECTOR BENEFITS

PUBLIC SECTOR BENEFITS
Access to latest technologies
Financial and human resources
Greater development benefits through support of more components of the economy
Increased resilience to climate change
Potential for revenue generation
Enhanced status and public support

PRIVATE SECTOR BENEFITS

PRIVATE SECTOR BENEFITS
New profitable markets
Potential for services in high demand—weather information
Access to more complete, government-managed data sets
Potential new products and services to retain existing customers for telecoms
Opportunity to show social responsibility (communicate emergency warnings)
Increased productivity in agriculture and other weather-dependent sectors

POTENTIAL RISKS

PUBLIC SECTOR RISKS

PUBLIC SECTOR RISKS
Mission and scope creep (the expansion of a programme beyond its original mission or goals)
Internal capacity development
Legal and regulatory challenges
Allocation of responsibilities
Departure from the status quo
Data ownership and IP challenges

PRIVATE SECTOR RISKS

PRIVATE SECTOR RISKS
Higher financial risk profile in developing economies
Legal and regulatory hurdles provide obstacles to achieving objectives
Infrastructure deficiencies for sustainable security, power, communications
Cultural gaps
Language gaps
Lack of successful models

Tracking Benefits

ECONOMIC

AGRICULTURE: Avoidance of crop losses from frost, hail, drought, flood or extreme temperatures; timing of crop protection, planting and harvesting; increased farm production and sales; more efficient scheduling of the use of agricultural machinery; minimization of drought relief costs.

AIR TRANSPORT: Reduced fuel consumption through route planning; improved scheduling of flight arrivals and departures; minimization of airline costs from aircraft diversions; minimization of search and rescue costs; reduction of accidents and emissions; savings in passenger times, materials and working times (airport maintenance).

MARITIME TRANSPORT: Reduction of accidents and environmental damages, fuel savings, more efficient rescue operations.

OIL PROSPECTING: Avoidance of unnecessary shutdown of offshore oil and gas operations; more efficient planning of energy production and delivery.

ENERGY: Prediction of power demands, power failure reduction, savings in material and working times (maintenance), energy savings.

CONSTRUCTION: Potential to eliminate serious construction problems a priori (risk control system).

FLOOD PROTECTION: Savings in human lives and property, more efficient rescue operations.

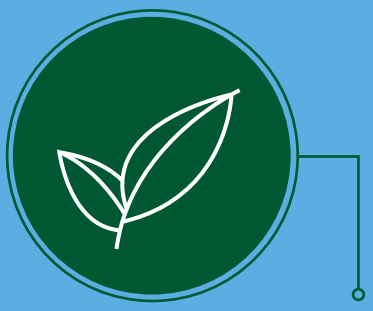
SOCIAL

PROTECTION OF LIFE AND PROPERTY: Avoidance of loss of life and property from natural disasters.

RESEARCH: Improved information and data to the scientific community.

LEISURE: Contribution to the day-to-day safety, comfort, enjoyment, and general convenience of citizens, including recreation, travel/commuting and other direct and indirect forms of societal benefits.

HEALTH: With improved information NHMS are able to provide advisories on malaria and other vector-borne outbreaks.



ENVIRONMENTAL

AIR QUALITY MONITORING AND WARNINGS: Reducing adverse health impacts; saving human lives in possible environmental accidents (evacuations); minimization of release of toxic substances and other pollutants; management of local environmental quality.

5:1

Return in economic development for every dollar spent on weather and climate services.

Source: MDA Information Systems, A Modernization Plan for Uganda's Meteorological Services (Report funded by USTDA, 2013).

About This Report

This report is a learning product from the UNDP's Programme on Climate Information for Resilient Development in Africa (CIRDA), a four-year programme supporting work in 11 African least developed countries with US$50 million from the Global Environment Facility's Least Developed Countries Fund (LDCF). As such, it builds on the expertise of the CIRDA technical team, the products of several workshops and experiences, and initial consultations between CIRDA experts and public and private representatives of countries assisted by UNDP. The vision described here is closely related to the work plan and activities of the CIRDA programme. Learn more about the CIRDA programme and get a full copy of the report at www.adaptation-undp.org/projects/cirda.

End Notes

[1] World Bank, 'Creating an Atmosphere of Cooperation in Sub-Saharan Africa by Strengthening Weather, Climate and Hydrological Services', Geneva, 2 June 2015.

[2] For more information on the Sustainable Development Goals, refer to www.un.org/sustainabledevelopment/development-agenda/

[3] World Bank, 'Poverty in a Rising Africa,' Washington, 2016.

[4] 'The WMO Strategy for Service Delivery', https://www.wmo.int/pages/prog/amp/pwsp/documents/SDS.pdf.

[5] WMO, 'Valuing Weather and Climate: Economic Assessment of Meteorological and Hydrological Services', 2015, WMO-No. 1153, "NMHS improvements to reduce disaster losses in developing countries—benefit-cost ratios (BCRs) range from 4-1 to 36-1. Drought early warning system in Ethiopia to reduce livelihood losses and dependence on assistance—BCRs range from 3-1 to 6-1." The economic returns of investments in weather services are explored later in this publication.

[6] On 12 December 2015, the 195 nations signatory to the UN Framework Agreement on Climate Change reached a historic agreement to combat climate change and redirect investment towards a more climate-friendly future. Learn more about the implications of the Paris Agreement on Climate Information and Early Warning Systems projects at undp-cirda.blogspot.com/2015/12/implications-of-paris-cop21-agreement.html. The primary source of donor funding for adaptation is now the Green Climate Fund; see www.greenclimate.fund.

[7] "Low investment [in hydromet services] is especially evident in Africa. The network of hydromet stations is sparse and deteriorating, and hydromet data are often spotty and inaccurate. Existing stations are often not functioning or fail to communicate with the global meteorological network. These shortcomings are especially serious given the large proportion of Africans engaged in agriculture and the very high variability of African precipitation relative to the mean." Independent Evaluation Group (IEG), World Bank, 'Adapting to Climate Change: Assessing World Bank Group Experience', ieg.worldbankgroup.org/Data/reports/cc3_full_eval_0.pdf.

[8] "Over 1985–2011, the World Bank has financed 132 projects that supported hydromet improvements. Twelve projects provided comprehensive support for national-level hydromet systems at a cost of $380 million. About nine-tenths of project funding went to 8 IBRD countries (Albania, Brazil, Dominican Republic, Mexico, Peru, Poland, Russia, and Turkey), while the remainder went to 4 IDA countries/regions (Afghanistan, Central Asia, Moldova, and Sri Lanka). An additional 120 projects (including 18 in Sub-Saharan Africa and 5 in the Middle East and North Africa) supported partial systems or specific needs, at a cost of at least $917 million." IEG, World Bank, 'Adapting to Climate Change: Assessing World Bank Group Experience'.

[9] World Bank, 'Creating an Atmosphere of Cooperation in Sub-Saharan Africa by Strengthening Weather, Climate and Hydrological Services'.

[10] In 2015, the Seventeenth World Meteorological Congress highlighted "the different, and at times, complementary roles and responsibilities of NHMSs, academic institutions, research and technological agencies, and the private sector and that closer interactions between the public and private sectors could stimulate innovation and facilitate cross-fertilization. WMO, as mentioned during the WMO Congress, "has a unique opportunity to initiate this interaction and emphasized that inaction may limit the benefits to be derived for the users." Engagement with the private sector requires special attentions. If private-sector providers are not engaged early on by NHMSs, such activities could also lead to proliferation of non-authoritative weather and climate information. This could challenge the NHMSs mandate to disseminate authoritative weather information and warnings to the public, media and disaster management authorities. With these challenges in mind, the WMO Congress "encouraged the development of specifications and service-level agreements by NHMSs in order to ensure accuracy, traceability and delivery of quality services to their end users."

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